

by the reticulate ornamentation of the teeth and the absence of lateral cusps; the cephalic spines agree; and the dorsal fin-spines merely differ in the prevailing replacement of a ribbed ornament by series of stellate tubercles.

## EXPLANATION OF PLATE XII.

*Asteracanthus ornatissimus*, var. *flettonensis*, A. S. Woodw., Oxford Clay, Fletton, near Peterborough.

- Fig.* 1. Right ramus of mandible, outer aspect,  $\frac{1}{3}$  nat. size. *t*, tuberosity. [No. 5.]  
*Fig.* 2. Teeth of upper jaw, series I-IV, upper aspect, nat. size. [No. 4.]  
*Fig.* 3. Teeth of lower jaw, series 0-IV, upper aspect, nat. size. [No. 4.]  
*Fig.* 4. Hinder tooth, upper aspect, nat. size. [No. 4.]  
*Fig.* 5. Anterior dorsal fin-spine, lateral aspect,  $\frac{2}{3}$  nat. size. [No. 4.]  
*Fig.* 6. Posterior ditto, lateral aspect,  $\frac{2}{3}$  nat. size. [No. 4.]  
*Fig.* 7. Cephalic spine, lateral aspect,  $\frac{2}{3}$  nat. size. [No. 1.]  
*Fig.* 8. Ditto, upper aspect,  $\frac{2}{3}$  nat. size. [No. 1.]  
*Fig.* 9. Tooth of (?) series III, upper aspect, nat. size. [No. 3.]  
*Fig.* 10. Two transversely-divided teeth of series IV, upper aspect, nat. size. [No. 3.]  
*Fig.* 11. Hinder tooth, upper aspect, nat. size. [No. 3.]

(The numbers refer to the Catalogue of the Leeds Collection.)

XLIV.—*Description of a Large Variety of Orbitolites Mantelli, Cart., from the West Bank of the River Irrawadi, in the Province of Pegu, Burma, about 36 miles above Prome.*  
 By H. J. CARTER, F.R.S. &c.

*Orbitolites Mantelli*, var. *Theobaldi*, n. var.

Discoid, slightly undulous, flat, thin. Consisting of a well-marked central plane of ?-spheroidal cells in juxtaposition, bordered on each side by several layers of vertically compressed ones presenting a more or less columnar arrangement. Central plane thinnest in the centre (where it generally commences around one or more comparatively large "primary cells" in conjunction, by which the centre, when thus exposed, is easily ascertained), increasing slightly in vertical diameter towards the circumference; structure of the central plane, when viewed in a vertical section, passing through the "primary cells" or centre of the fossil, presenting, for the most part, quadrangular spaces. Disk of the largest specimen exposed about  $3\frac{1}{8}$  inches in horizontal diameter by  $\frac{1}{8}$  inch

vertically in the centre, from which point it gradually and uniformly diminishes to the thinness of a wafer at the circumference. Layers of compressed cells on each side of the central plane, amounting in the centre of a vertical section to about sixteen, diminishing in this respect towards the circumference, presenting in the horizontal section the same cells under a circular or hexagonal form, in juxtaposition but for the intervention of a thin line of translucent shell-substance, through which, in specimens infiltrated with red or yellow oxide of iron, the intercellular canals of communication, by their opaque yellow colour, may be seen to pass, but no columns of the opaque white, shelly substance which especially characterize this structure in *Orbitoides dispansa*. These layers of vertically compressed cells present, in the horizontal planes, a similar arrangement to the centrifugal lines of an engine-turned watch-case, and are covered in on both sides by a very thin superficial or terminal layer, in which the cells markedly differ from those of the subjacent planes in the irregularity of their outline and their variability in size, although, under the microscope, they also may be seen to be separated by the thin line of intercellular translucent shell-substance, like that which, in the infiltrated specimens, is traversed by the canals of intercellular communication as in those of *Orbitoides dispansa*, but none of the "conical columns of non-tubular substance" of the late Dr. Carpenter ('Introduction to the Study of the Foraminifera,' p. 302), that is, of our opaque white, shelly substance which so essentially distinguishes this species from *Orbitolites Mantelli*, Cart., as before mentioned. General appearance of the "hand-specimens" under examination, which indicates that of the stratum from which they were taken, sandy; the matrix consisting of a combination of microscopic grains of quartz and a small quantity of argil together with a considerable portion of microscopic Foraminifera, in the proportion of 2 of the former to 1 of the latter, in which the specimens of *Orbitolites Mantelli*, var. *Theobaldi*, which are composed of apparently homogeneous, semitranslucent calcite, in a compact or crystalline state, lie, like a collection of large leaves, thus contrasting forcibly in their homogeneity and general appearance with the gritty character of the matrix. Colour of the matrix grey when fresh, rusty brown after exposure, tough, breaking with a rough fracture; structure laminar from the presence of the leaf-like fossils. Microscopic Foraminifera consisting chiefly of Discoids and *Textulariæ*. Although the hand-specimens, which altogether present about 150 square inches of surface, were carefully examined all over with a strong lens, I could

not discover even a trace of any other foraminiferal test beyond those mentioned; this is the opposite to those from Upper Sind, which are in the midst of a mass of middle-sized Nummulites.

*Loc.* Village of Peitating (? Pinthaling), on the western bank of the river Irrawadi, about 36 miles above Prome, or 6 miles below Thayetmyo, in the Province of Pegu, Burma.

*Obs.* Of the stratum from which the two hand-specimens above mentioned were obtained, Mr. W. Theobald (who submitted them to me for examination and after whom the variety of *Orbitolites Mantelli* contained in them has been named) states, in his published "Report on the Geology of Pegu" (Memoirs of the Geological Survey of India, vol. x. p. 87), as follows:—

"Except in the Kama shale, Foraminifera are scarce throughout the beds of this group. A single specimen of an Orbitolite was found in the *Cythereamensis* bed, opposite Prome, which, when perfect, might have been the size of a shilling, but with a thickness no greater than cardboard. A careful search, however, failed to discover a second specimen. Another species of Orbitolite forms the characteristic fossil in a hardish sandstone on the banks of the Irrawadi, a little above the Lime Hill; but unfortunately the position of the bed is not very clear, neither does the fossil occur anywhere else that I know of. A perfect specimen must have measured five or six inches across, with a thickness of not more than the tenth of an inch, and these organisms are, in parts of the rock, packed together so closely that the section of them on the surface suggests the idea of a cross-cut through a bundle of little pancakes."

As regards the largest size that this fossil may attain, it will be observed that Mr. Theobald's measurements much exceed my own in horizontal diameter, that is "across;" but then it should be remembered that mine were taken from the largest specimen exposed in the "hand-specimens," while Mr. Theobald's were made on the spot, that is, where the stratum charged with them in the bank of the Irrawadi existed; at the same time my own measurement in horizontal diameter exceeds that of any discoid species of Foraminifera on record. And as regards the geological position of the stratum, I must refer the reader to that part of Mr. Theobald's report bearing upon the subject, merely observing that the "Lime Hill" (so called from the lime-kilns supplying Thayetmyo being situated on it) to which he again alludes further on, at p. 92, &c., consists of "a mass of nummulitic strata, forced up through the newer Tertiaries, and forming a conspicuous landmark

for the district." This, which is also marked on his map, is less than a mile in length by half a mile broad, stated by Mr. Theobald from memory to be about "400 feet high," and separated from the river by a "narrow strip" of his "Newer Tertiaries," about 32 miles above the town of Prome, which "Tertiaries" on the other side also separate it again from the *main* area of nummulitic strata whose vertical section is especially well seen in a small stream at the village of Thambola, about 34 miles nearly due west of the "Lime Hill," and of which section, at p. 98 &c. of his Report, a detailed statement is given, condensed at p. 100 into the following generalized one:—

1. Nummulitic Limestone.....	feet. 10
2. Shales and Sandstones; Shales occasionally Nummulitic .....	658
3. Massive Sandstone with some Shales and much soda-efflorescence in places.....	328
4. Shales and Sandstones; the Shale with some Carbonaceous markings .....	227
Total.....	1,223

So much for this variety of *Orbitolites Mantelli*, and the assumed geological position of the stratum charged with it, which is contained in Mr. Theobald's "Report." I have now, in conclusion, to offer a few explanatory remarks on the name "*Orbitolites Mantelli*" which I adopted in 1853 (Journ. Bombay Asiatic Society, vol. v. p. 138), as my kind friend the late Dr. Carpenter, in his excellent 'Introduction to the Study of the Foraminifera' of 1862, p. 298, considered it, viz. the term "*Orbitolites*," to have been adopted on "fallacious grounds."

In 1834, S. G. Morton (Synopsis of the Organic Remains of the Cretaceous Group. 8°. Philadelphia, U.S.) mentioned the occurrence, in the Claiborne Beds of Alabama, of a discoid fossil which he called *Nummulites Mantelli*; and 13 years afterwards, viz. in 1847, D'Orbigny ('Cours de Géologie,' vol. i. p. 194, and 'Prodrôme,' 1850, vol. ii. p. 406, respectively) used the name "*Orbitoides*" for this and similar fossils under the following diagnosis, accompanied in the preceding page by a typical illustration:—

"Coquille discoïdale, convexe des deux côtes, formée d'une seule rangée de loges autour du disque, très fortement encroûté extérieurement au milieu, et montrant soit des linéoles rayonnantes, soit des granulations" (Cours, vol. i. p. 194). Thus he includes under this generic heading not only the Alabama fossil (Prodrôme, vol. ii. p. 406), but

the *Nummulites papyracea* of Boubée, 1832 = *Orbitolites Pratii* of Michelin, 1846 (*ib.* p. 334) = *Lycophrys dispansus* of Sowerby, 1837 (see Carpenter's 'Introduction,' p. 298), and therefore my *Orbitolites dispansa* of 1853 (Journ. Bombay Asiatic Society, vol. v. p. 136)—that is, the Alabama fossil, whose structural type is depicted in the "Parisien" species *Orbitoides media* on the page preceding D'Orbigny's diagnosis; and *Orbitoides dispansa*, previously called *Lycophrys dispansus* by Sowerby, whose structure, which is totally different, was depicted ten years previously in the illustrations to Captain Grant's Memoir on the Geology of Cutch, published in 1837 in the Transactions of the Geological Society of London (vol. v. p. 289, pl. xviii. figs. 16, 16 a, and 16 b).

In 1861 my paper on the "Foraminifera of Sind, with Observations on their Internal Structure," was republished, with additions, in the Ann. & Mag. Nat. Hist. for that year (vol. viii. p. 309), and at page 328 the genus *Orbitoides* is thus alluded to:—

"*Orbitoides*, d'Orb.

"In this family two distinct genera have been included, viz. *Orbitoides dispansa* and *Orbitoides Mantelli*, D'Orb. (*Orbitolites Mantelli*, Cart.), as will be seen by their descriptions hereafter under their respective heads. Moreover, it will also be seen there that they are so different that they can hardly be included even in the same family: at least, while the former is closely allied to *Cycloclypeus*, Carp., the latter is so closely allied to *Orbitolites* that I proposed the name of '*Orbitolites Mantelli*' for it, instead of '*Orbitoides*.'"

Following this is a detailed description of *Orbitoides dispansa* and of *Orbitolites Mantelli* respectively, whose differences, to make them more clear, are delineated in plate xvi. of the illustrations, in two columns side by side, which thus occupy the whole of the plate, together with separate and still more detailed descriptions of them at pp. 446 and 452 respectively of the same volume, wherein again their distinctive characters are repeated.

Dr. Carpenter has stated at p. 302 (*op. cit.*) that:—"In both forms of *Orbitoides*, and not (as stated by Mr. Carter) in *O. Fortisii* [= *Orbitoides dispansa*], we often find the superficial layers traversed by columns of non-tubular substance, which are of a conical form" (Dr. Carpenter's name for "Discolithus IV. a of Fortis" appears to be *Orbitoides Fortisii* = *Lycophrys dispansus* = my *Orbitoides dispansa*, 'Introduction,' p. 298).

This I have never seen in any of my specimens of *Orbitolites Mantelli*, either from Arabia, Kelat, or Sind, nor in that from Burma above described, while Dr. Carpenter himself adds just afterwards:—"in the American variety of *O. Mantelli* I have not met with any indication of the presence of these columns."

Sometimes the columns of cells in *Orbitolites Mantelli* do, in the vertical section, present a white appearance like the "columns of non-tubular substance" in *Orbitoides dispansa*, especially where the rest of the fossil is composed of dark grey calcite; but, then, the lighter-coloured correct the darker specimens in this respect; and if this does not suffice, we have only to turn to the specimens of *Orbitoides dispansa* and *Orbitolites Mantelli*, whose cavities respectively have been infiltrated with red or yellow oxide of iron, to see that the cells in the former are accompanied by the opaque white "columns of non-tubular substance;" while in the latter they are *not* so, but merely surrounded by the thin layer of translucent shell-substance, through which, as before stated, the "canals"—now rendered visible by being filled with the oxide of iron—may be seen to connect the contiguous cell-cavities.

After all, Dr. Carpenter states at p. 299 (*op. cit.*) that "There is so decided and constant a difference as regards the form of the chambers between *O. Mantelli* and *O. Fortisii*, that until such a gradational series of connecting links shall be discovered as unites the similarly diversified varieties of *Orbitolites*, they must be retained as distinct species." The distinctive differences of *Orbitoides Fortisii*, Carp., = *Orbitoides dispansa*, Cart., and *Orbitoides Mantelli* = *Orbitolites Mantelli*, Cart., are as clearly given in his twentieth plate as they are in my own, to which I have before alluded; and Gümbel, in 1869, makes the same distinction, proposing for the latter the name "*Lepidocyclina*," of which he states:—"Mediankammern auf dem Horizontalschnitt peripherisch halbkreisförmig abgerundet. (Bei den vorhergehenden Untergattungen [that is, *Orbitoides dispansa* &c.] dagegen rektangulär.)"—Bütschli, in Bronn's Klass. u. Ord. des Thierreichs, 1880, Rhizopoda, p. 216.

To sum up, the central plane of *Nummulites* corresponds to the form and arrangement of the plane of chambers in *Operculina*; that of *Orbitoides dispansa* to the form and arrangement of the plane of chambers in *Cycloclypeus*, Carp., together with the initiative "cones of non-tubular substance" as delineated in Dr. Carpenter's fig. 5, pl. xix.; and that of *Orbitolites Mantelli* to the form and arrangement of the single

plane of cells presented by the most simple form of the existing species, viz. *Orbitolites marginalis*, Lamarck (1816, vol. ii. p. 196), which is almost ubiquitous between the shores of the Mediterranean and those of the south coast of Australia, if not elsewhere in these latitudes.

The identity of structure, although not exactly of form, in all the specimens of *Orbitolites Mantelli*, var. *Theobaldi*, compels me to consider the latter only a "variety;" while, as before stated, it is by far the largest discoid specimen of the Foraminifera on record.

XLV.—*Note on the Bib and the Poor- or Power-Cod.*

By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.

I REGRET that a little delay has occurred in the performance of my duty in regard to Surgeon-General Day's remarks on these fishes; but constant occupation in other departments prevented attention to the subject till now.

In my 'Catalogue of the Fishes of St. Andrews' (1875) the bib (*Gadus luscus*) and the poor-cod (*Gadus minutus*) were, as the author just mentioned truly says, entered as separate species, and it was only recently that the confusion in the descriptions of these forms struck me, as it probably also did Winther. A reexamination, however, shows that the earlier view (and Mr. Day's) is correct. In the 'British Fishes' of the latter author the distinctions rest on the proportions of the depth to the length of the body and the larger barbel of the bib\*. The first dorsal is stated to have the same number of rays in both; the second to have a larger range and a few more rays in the poor-cod than in the bib. The first anal has more rays in the bib and arises nearer the vent than in the poor-cod; while the second has somewhat fewer rays than in the latter, and the fin in the former also arises further forward. Moreover, in his recent paper † Mr. Day correctly points out that these two fins have a more evident interval than in the bib. The lateral line in the latter is stated to curve very gently to the last half of the second dorsal, and then goes straight to the caudal, whereas in the poor-cod it is very slightly bent, becoming straight beneath the second third of the dorsal fin. In Mr. Day's figure of the latter, however, the curvature is less marked than in any example hitherto observed. The vent lies beneath the anterior portion of the dorsal fin in the bib, whereas in the poor-

\* In a bib  $13\frac{1}{4}$  inches long the barbel was about  $\frac{3}{4}$  inch long and proportionally thick.

† Ann. & Mag. Nat. Hist., Feb. 1888.